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DTG:

172015Z April

Sent to Chief of Staff
CENTCOM

From JCS
To
DJS WASHINGTON DC//
USCINCCENT

UNCLAS

SUBJ: ENVIRONMENTAL HEALTH MONITORING AND RISK ASSESSMENTS - KUWAIT
OIL FIRE SMOKE

1. THE DASD (ENVIRONMENT) HAS ASKED THE JOINT STAFF TO ASSIST IN PLACING A HEALTH RISK ASSESSMENT TEAM IN THEATER TO COLLECT AND ANALYZE ENVIRONMENTAL SAMPLES FOR POTENTIALLY HAZARDOUS COMPONENTS OF OIL FIRE SMOKE.
2. PREVIOUS ANALYSIS DONE BY THE ENVIRONMENTAL PROTECTION AGENCY (EPA) IS INCONCLUSIVE AND HAS NOT ALLOWED EVALUATION OF THE MAGNITUDE OF HEALTH RISK FOR BOTH THE SHORT AND LONG TERM. ADDITIONAL MEASUREMENTS AND SURVEYS ARE REQUIRED.
3. THE ARMY SURGEON GENERAL HAS THE DOD LEAD ON THIS ASSESSMENT. A TEAM OF ELEVEN MEMBERS FROM THE US ARMY ENVIRONMENTAL HYGIENE AGENCY IS PREPARED TO REPORT WITHIN THE NEXT TWO WEEKS. DURATION OF TIME IN THEATER WILL BE DEPENDENT UPON THE SUCCESS OF THEIR EFFORTS.
4. REQUEST YOUR APPROVAL FOR THIS TEAM TO DEPLOY TO THE THEATER. RESOURCES FOR SHELTER, RATIONS, TRANSPORTATION, ELECTRICAL POWER AND

MARY T. FRY, COL. USA
HRD/J-4/74421

#909

Releaser

JSISC ALTERNATE MESSAGEFORM

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OTHER LOGISTICAL SUPPORT WILL BE COORDINATED WITH YOU DIRECTLY BY ARMY.

5. THERE IS GROWING CONGRESSIONAL, SCIENTIFIC, AND PUBLIC INTEREST IN PROTECTING THE HEALTH OF OUR PERSONNEL AND LIMITING ANY FUTURE LIABILITIES AND CONTROVERSIES. TIMELY COLLECTION OF SOLID SCIENTIFIC DATA IN ORDER TO HELP ESTABLISH DOD POLICIES FOR EXPOSED PERSONNEL AND MEDICAL FOLLOW-UP IS CRUCIAL.

6. REGARDS

INIT: _____

JSISC ALTERNATE MESSAGEFORM

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TO DJS	CLASSIFICATION UNCLASSIFIED	ACTION NUMBER	ORIG SUB
THRU	<input checked="" type="checkbox"/> ACTION <input checked="" type="checkbox"/> APPROVAL <input type="checkbox"/> SIGNATURE <input type="checkbox"/> INFORMATION		CJCS SUB
SUBJECT Environmental Health Monitoring and Risk Assessments - Kuwait Oil Fire Smoke - DESERT STORM		CJCS NUMBER	SJS SUSP 25 Apr J SUSPENS 22 Apr

ACTION SUMMARY

1. **Purpose.** To obtain CENTCOM approval to send a team from the US Army Environmental Hygiene Agency to the theater to collect and analyze environmental samples for potentially hazardous components of oil fire smoke.
2. **Background.** The DASD (Environment) wrote DJS requesting assistance in sending an Army team to CENTCOM to assess potential exposure and health risks due to oil fire smoke in order to help answer any future questions about possible adverse health effects of DESERT STORM service.
3. **Discussion:**
 - a. The Environmental Protection Agency (EPA) is leading the inter-agency effort. Previous EPA tests are inconclusive, not allowing complete evaluation of health risk for both short and long term exposure. Additional measurements and surveys are needed.
 - b. CENTCOM has performed air sampling studies and held meetings with coalition partners, EPA, DOS and began a USMC controlled study of long, short, and no exposure groups.
 - c. Army is ready to send an eleven member team within the next two weeks. The team would conduct air monitoring and evaluations beyond CENTCOM's capabilities. Results will assist medical authorities in determining both short and long-term health risks.
 - d. Telephone conversation on 15 April with the CENTCOM Surgeon's office indicated there would be no objection to having the Army team in theater.

COORDINATION/APPROVAL

OFFICE	NAME & DATE	EXT	OFFICE	NAME & DATE	EXT
			DDMR/J4	RAHM SMITH	743
			ADDENA/	J5-RAHM RUCK	7839
			OASD(PL&E)	BLOND	
				MR. SIKBERT	5011

ACTION OFFICER/DIV/PHONE COL Mary T. Fry, JS/J-4/MRD, 697-4421

DATE PREPARED April 1991	CLASSIFICATION UNCLASSIFIED	Classified by Declassify on
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JS FORM 1381
FEB 90

Internal Staff Paper, Release Covered by NIP 35
PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

4. Recommendation: DJS sign the attached message to CENTCOM.

Attachment

Reference

* SJS 2571/585-01



HEALTH AFFAIRS

THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D. C. 20301-1200

4 APR 1991

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (M&RA)
ASSISTANT SECRETARY OF THE NAVY (M&RA)
ASSISTANT SECRETARY OF THE AIR FORCE (MRAI&E)

SUBJECT: Health Risk Assessments - Kuwait Oil Fire Smoke

This is to request assistance in determining the current status of efforts to assess the health risk to U.S. military personnel potentially exposed to smoke from Kuwait oil fires, and assistance in evaluating any potential longer term health risk.

Department of Defense personnel have been attending meetings of the Environmental Protection Agency (EPA) lead interagency working group and have been working to determine what policy should be established regarding the assessment of both short and long-term health risk. At TAB A is a summary of events to date. At TAB B are background documents of interest.

I plan to organize a Tri-Service working group of health professionals, including personnel with expertise in occupational medicine, preventive medicine, environmental health, and industrial hygiene, to assess the health risk to our personnel. Further, I request that Army act as the Executive Agent for this effort. The working group would support United States Central Command's (CENTCOM) current activities and conduct evaluations of risk beyond CENTCOM's capabilities. We need solid scientific data on which to establish long-term DoD policy for our personnel. These policies concern personnel being exposed in Kuwait, and medical follow-up once personnel return to the United States.

Please designate at least two representatives to the working group with expertise as noted above. Service nominees should be selected by 12 April. Initially, weekly meetings are anticipated. Telephonic notification of nominees is permissible. Commander St. Andre, USN, MC, (703) 695-7116 is the point of contact within OASD(HA).


Enrique Mendez, Jr., M.D.

CC:
DASD (Environment)

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JOINT STAFF
INFO SERVICE CENTER

ROUTINE
R 261310Z APR 91 ZFF-4
FM JOINT STAFF WASHINGTON DC//DJS//
TO USCINCCENT MACDILL AFB FL//CS//
INFO USCENTCOM HQS ELEMENT RIYADH SA

ZYUW RUEKJCS2950 1161333

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SUBJ: ENVIRONMENTAL MONITORING AND HEALTH RISK ASSESSMENTS - KUWAIT
OIL FIRE SMOKE - REQUEST FOR INFORMATION

1. THE ASD (HEALTH AFFAIRS) (ASD(HA)) HAS ASKED THE JOINT STAFF TO ASSIST IN GETTING A REPORT ON ACTIONS TAKEN TO PROTECT THE HEALTH OF US TROOPS FROM THE EFFECTS OF THE KUWAIT OIL FIRE SMOKE AND TO CHARACTERIZE THE LEVELS OF CONTAMINANTS TO WHICH THEY HAVE BEEN EXPOSED.
2. THIS INFORMATION WILL ALLOW THE ASD(HA) TO COMPLETE THE EVALUATION OF THE MAGNITUDE OF HEALTH RISKS ASSOCIATED WITH THE OIL FIRE SMOKE AND THE FORMULATION OF POLICIES TO PROTECT THE HEALTH OF OUR PERSONNEL. THE FOLLOWING IS NEEDED ASAP:
 - A. ACTIONS WHICH HAVE BEEN TAKEN IN THEATER TO PREVENT UNNECESSARY EXPOSURE OF US TROOPS TO SMOKE;
 - B. ESTIMATED NUMBERS OF INDIVIDUALS WHO HAVE BEEN EXPOSED TO SMOKE AND THE ESTIMATE OF DEGREE OF EXPOSURE EXPERIENCED; AND
 - C. ENVIRONMENTAL SAMPLING WHICH HAS BEEN CONDUCTED TO CHARACTERIZE THE LEVELS OF EXPOSURE TO THE SMOKE. THE INFORMATION ON SAMPLING SHOULD INCLUDE DATA ON THE LOCATION FROM WHICH THE SAMPLES WERE OBTAINED, THE SAMPLING TECHNIQUE USED, AND THE LEVELS OF CONTAMINANTS WHICH WERE DETECTED.
3. IT IS ESSENTIAL THAT DOD MOVE AHEAD TO COLLECT EXPOSURE DATA AND IDENTIFY DOD PERSONNEL OR UNITS WHO ARE PRESENTLY SERVING, WHO HAVE SERVED, OR WHO WILL SERVE IN AREAS CONTAMINATED BY THE OIL FIRE SMOKE.
4. REGARDS BT

TMSVC ZDF REQUIRED

*****DESERT STORM TRAFFIC*****

*****SPECAT TRAFFIC LOGGED ON FORM 5*****
FINAL DISTR ADDED FOR JCS PER COL TURNER /OSJS_____

ACTION CJCS=(9) TERM SVC(1)
INFO SJS(1) NIDS(1) DODDIV(1) J4(9)

(M)

MCN=91116/04144

TOR=91116/1333Z

TAD=91116/1344Z

CDSN=MAZ067

PAGE 1 OF 1
261310Z APR 91

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OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, DC 20301-8000

11/15/87-24

LOG

May 13, 1991

MEMORANDUM FOR DR. DAVID AUTON, DEFENSE NUCLEAR AGENCY

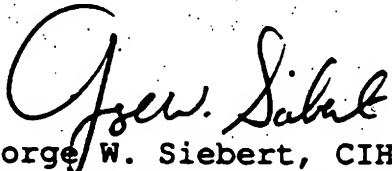
SUBJECT: KUWAITI OIL FIRES

This is to follow-up our recent conversation and forward for appropriate action the attached letter of May 9, 1991, from the United States Department of State concerning Kuwaiti oil fires measurements.

I concur with the concept that DNA serve as the DoD focal point to coordinate atmospheric sampling. I also agree with DNA's proposed DepSecDef reply to the President's Science Advisor, Dr. Bromley, which will recognize DNA's coordination role and provide guidance on DoD's support to other agencies and organizations.

With respect to our initiative to assess acute, intermediate, and long term health effects to DoD military and civilian personnel, the U.S. Army Environmental Hygiene Agency has deployed a team of environmental health experts; i.e., industrial hygienist, physician, chemist, and technicians to the theater. Environmental and clinical data will be evaluated by the DoD Kuwaiti Oil Fire Health Effects Working Group. The Group was chartered by Dr. Mendez, ASD(HA) and is chaired by COL F.J. Erdtmann, MC. Minutes of the Group's April 22nd meeting are attached. We will keep you informed of our progress.

Please contact me on 695-0110 if I can provide any additional information.


George W. Siebert, CIH
Director for Safety and
Occupational Health Policy

Attachments

cc: LTC Winslow, OJCS/J5
COL M.T. Fry, OJCS/J4
COL Erdtmann, SGPS-PSP
CDR St. Andre, OASD(HA)
COL Bob Stone, ODASD(E)
David Platt, ODASD(E)

Health Effects of Oil Well Fire Smoke

DoD Status Report

11 June 1991

Background

More than 400 oil well fires are currently burning in Kuwait.

The smoke originates from seven oil fields, located both north and south of Kuwait City, the majority in the Al Burgan oil field south of the city.

About 60 of the wells are considered "high sulfur"; only about 30 are burning according to EPA.

The fires have abundant oxygen supplies and show temperatures that are extremely high. This appears to result in essentially complete combustion of organic materials.

Of note, incineration at high temperature is a primary means of disposing of known toxic wastes.

Interagency Air Assessment Team

On February 28, 1991 the Saudi government requested U.S. technical assistance through the U.S. Embassy to evaluate the health and environmental impacts of these fires.

An interagency team consisting of individuals from EPA, NOAA, and DHHS deployed to Kuwait. In country, this team collaborated with representatives from DoD, the U.S. Coast Guard, and DOE.

The team's mission included assessing potential health effects through air sampling and monitoring, reviewing the health infrastructure, determining the capability of the region to deal with the health threat, and providing technical assistance.

Potential Health Effects

Acute, short term:

**Examples - Carbon Monoxide poisoning
Hydrogen Sulfide poisoning**

Current experience -

No observed increase in illness rates

**Air samples show low levels of
potential acute toxins**

Intermediate term:

**Examples - Lead poisoning
Hydrocarbon neurotoxicity**

**These effects become visible only
after a period of several months to
a few years.**

Current experience -

No observed increase in illness rates

**Air samples show low levels of
potential acute toxins**

Potential Health Effects

Long term:

**Examples - Leukemia (Hydrocarbons)
Emphysema (Particulates)
Lung Cancer
(Hydrocarbons)**

These effects become visible after many years and usually involve chronic exposure to the responsible agent.

The number of individuals who develop disease compared to all individuals who are exposed to the agent (rate/100,000) is usually small.

Current experience -

Due to the complexity of the measurements and the effects of environmental variables, the estimation of exposure and identification of causal relationships is scientifically imperfect.

Health Protection Measures

Immediate actions -

Avoid all unnecessary exposure.

Protect lungs with a scarf or dust mask.

Protect eyes with goggles.

Cover exposed skin surfaces.

Intermediate actions -

Implement a medical surveillance program to monitor for intermediate and long-term health effects based on the findings of a systematic exposure risk assessment.

Health Protection Measures

Long range actions -

Conduct epidemiologic studies to evaluate the data collected through the medical surveillance program.

These studies determine the types of diseases potentially caused by the exposures as well as the rate of disease occurrence among exposed individuals.

These studies will be necessary to clarify whether or not any diseases which occur in the future are caused by exposure to the oil fire smoke.

DoD Actions to Date

CENTCOM issued guidance about personal protective measures to U.S. forces in theater.

ASD(HA) established a standing working group composed of appropriate health specialists to evaluate clinical and environmental sampling data, develop an appropriate medical surveillance program, and plan for conducting epidemiologic studies in the future.

ASD(HA) requested through JCS that CENTCOM provide a report of all actions taken in theater to protect the troops, evaluate potential acute health effects, and document individuals' potential exposure to the oil fire smoke.

DoD Actions to Date

DASD(Environment) requested JCS assistance in asking CENTCOM to collect additional environmental health data utilizing a team from the U.S. Army Environmental Hygiene Agency. (Departed 1 May 1991)

Representatives from OASD(HA) and OASD(P&L) have participated in the EPA coordinated Interagency Air Assessment Team activities.

DoD Initiatives to Evaluate **Health Effects from the Oil Fires**

**All Services are attempting to
collect acute illness rates before
and after the oil well fires,
especially for respiratory ailments.
(Inpatient and Outpatient)**

**Navy is conducting an epidemiological
study of about 2500 Marines who
were at three sites at varying distance
from the oil fires looking to see
if the sick call rates were higher
in those whose exposure was greater.**

Quantitative

Risk Assessment Study

Being conducted by :

US Army Environmental Hygiene Agency

**Team deployed to Persian Gulf region
1 May 1991; still operating there**

**Collecting air samples at 7 sites in
Saudi Arabia and Kuwait to characterize
exposure of the DoD population**

Using standard EPA risk assessment methods

Will analyze constituents in the smoke

**Will develop a model to estimate level
of exposures of the military population
based on their location, time on
location, and meteorological conditions**

**Will be able to determine level of
excess risk of cancer endpoints
from specific chemicals in the smoke**

Medical Surveillance

11 ACR Study

Elements of 11 Armored Cavalry Regiment replacing other units in Kuwait will be departing Germany mid-June and remaining for 2 to 3 months.

Approx 2000 troops will have baseline health eval using questionnaires. Subset to get pulmonary function tests, blood tests (heavy metals, genotox screen, plasma volatile hydrocarbons)

Repeat blood tests (biomonitoring) and air pollution monitoring to be done at their location in Kuwait. Sick call rates will be monitored while in Kuwait.

Post deployment health eval to be conducted with questionnaire after return to Germany. Pulmonary and blood tests will be repeated.

Study will help determine exposure dose response relationship and contribute greatly to the overall risk assessment process.

Present Concerns

Some EPA, and press comments have generated an impression that most of over 500,000 troops have been continuously exposed to this smoke.

Some Congressional concern has been expressed about DoD's efforts to protect U.S. personnel from exposure to the smoke, oil spray and soot.

Future Concerns

Reports about the health and environmental effects of these fires from the scientific community, including the Public Health Service and the CIA, may raise serious questions about the health of U.S. troops for many years to come.

The potential health effects to the Kuwaiti people from years of exposure to these pollutants is being inappropriately linked to the potential effects U.S. troops may experience in the future from significantly shorter exposures.

Several other federal agencies have interests in the long-term impact of these fires on the overall environment in Kuwait which may confuse health related issues with environmental issues.

ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, DC 20301-8000



EXECUTIVE SUMMARY

MEMORANDUM FOR THE SECRETARY OF DEFENSE

THRU DEPUTY SECRETARY OF DEFENSE
ACTING UNDER SECRETARY OF DEFENSE (ACQUISITION)

FROM: ASSISTANT SECRETARY OF DEFENSE (PRODUCTION AND LOGISTICS) *G. Siebert 4/18*

SUBJECT: Environmental Health Impact of Kuwait Oil Smoke

PURPOSE: INFORMATION - Inform SecDef of actions to assess potential hazards.

DISCUSSION:

- o Congress is reviewing what actions the United States should be taking now to ensure the protection of our military and civilian personnel from potential short and long-term health hazards from the Kuwait oil well fires. In addition, several Agencies and private groups are attempting to secure funding from DoD (and elsewhere) for environmental and health effects research.
- o To date DoD has relied primarily on EPA-led studies. The EPA Interagency working group key conclusion was "Current data cannot be used effectively in a risk assessment, especially for long-term risk." EPA now reports that its preliminary studies need significant expansion. My office has asked JCS to request CENTCOM and the Army to undertake additional monitoring in cooperation with the EPA (Tab A). Monitoring teams are prepared to leave when clearance from CENTCOM is obtained. Results will be assessed by the ASD(Health Affairs) chartered Tri-Service working group.

RECOMMENDATION: None. ASD(HA) and ASD(PA) concur at Tab B. No response from ASD(LA).

Prepared by: G.Siebert/ODASD(E)/S&OH/x50110/11APR91
Approved by: Thomas E. Baca, DASD(E) *MB* Date 4-16-91



THE OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-6000

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APR 11 1991

PRODUCTION AND
LOGISTICS

MEMORANDUM FOR DIRECTOR, JOINT STAFF

SUBJECT: Environmental Health Monitoring and Risk Assessments
- Kuwait Oil Fire Smoke

This is to request JCS assistance in asking CENTCOM to collect environmental health data for use in: (1) assessing the acute health risks to DoD personnel exposed to the smoke from the Kuwait oil fires, and (2) evaluating the potential long-term health risk to our personnel.

The Environmental Protection Agency (EPA) is leading an interagency working group to determine both short and long-term hazards to various populations at risk; i.e., Kuwaiti and Saudi civilians, U.S. Embassy staff and dependents, U.S. civilian workers and families, and DoD military and civilian personnel. The EPA working group believes that there are increased health risks. However, they cannot determine the magnitude of the risk with any degree of certainty without further measurements and surveys (Draft Interagency Interim Report - Attachment 1). The EPA health assessment team concluded "Current data cannot be used effectively in a risk assessment, especially for long-term risk" (Attachment 2).

The ASD(Health Affairs) has formed a Tri-Service working group to evaluate EPA and DoD data on potential health hazards. The Army Surgeon General has the DoD lead on the assessment (Attachment 3). Their efforts could be limited, however, because of the preliminary nature of the initial air sampling data from the EPA team.

Your assistance is needed to ensure a team of DoD scientists and engineers collects environmental health samples at DoD military and civilian personnel locations for use in assessing the health risk to our personnel. The team would support CENTCOM's current medical activities and conduct air monitoring and evaluations of risks beyond CENTCOM's capabilities. This monitoring would be in addition to any air monitoring done or planned to be done by the EPA for the State Department or the Governments of Kuwait and Saudi Arabia. The DoD team should work with and share information with the EPA team to assure consistency and validity of the data.

We need to take aggressive action now to ensure the timely collection of solid scientific data in order to help establish DoD policies for: (1) our currently exposed personnel, and

(2) medical follow-up or compensation, now or in the future. It is essential that DoD move ahead to collect exposure data and identify DoD personnel or units who are presently serving, who have served, or will serve in areas impacted by the oil fire smoke. Data collection efforts now will help answer any future questions about possible adverse health effects of Desert Storm service. Timely data are also essential to communicate true risks to our personnel and their families. Since the U.S. Army Corps of Engineers has a substantial role in the reconstruction of Kuwait, these data are necessary to program any necessary health precautions to protect Corps military and civilian personnel who may have extended exposure times.

We understand that the U.S. Army Environmental Hygiene Agency (USAEHA) is prepared to dispatch an environmental health monitoring and health risk assessment team to the theater. With CENTCOM concurrence and in theater support, we request that you ask the Army to deploy the USAEHA team within two weeks.

The USAEHA Team should report through the Army Surgeon General to the Tri-Service working group on a weekly basis. The scope and protocol of the environmental health monitoring should be coordinated with the Tri-Service working group, CENTCOM and the EPA.

Congressional, scientific and public interest in this issue is growing. We view the above actions necessary to help protect the health of our personnel and to limit any future liabilities and controversies.

Thank you for your assistance. Please contact George Siebert on (703) 695-0110 if any questions should arise.



Thomas E. Baca
Deputy Assistant Secretary of Defense
(Environment)

Attachments (3)

cc: (w/o attachments)
ASD (Force Management and Personnel)
ASD (Health Affairs)
ASA (MR&A)
ASA (IL&E)
ASN (M&RA)
ASN (I&E)
ASAF (MRAI&E)
ODASD(NESAA) (CAPT Bolton)
OCJCS/CSG (CAPT Brodsky)

- LOG
3. The results of the current monitoring findings and health interviews with medical personnel in the affected areas suggest that at the present time susceptible subpopulations, such as individuals with asthma and chronic obstructive lung disease, may experience exacerbation of their symptoms. Special health concerns, warnings, advisories, and precautions are clearly warranted for these individuals. However, this does not appear to be life threatening under current exposure conditions. However, if meteorological conditions change, i.e., poor air mixing or plume touchdown, there could be adverse health effects; and,
 4. The long-term effects on health are not readily ascertainable at this time due to insufficient data on the populations exposed, the composition of the smoke plume, the impact of oil pools, and long-term meteorological patterns. The Kuwaiti and Saudi health communities have historically focused on communicable diseases from a public health standpoint and do not possess the necessary logistical capabilities for responding to environmental health issues. However, both the Kuwaiti and Saudi health communities have expressed great interest in obtaining training and support from the US medical community that can be continued by themselves in future years. Aggravating the problem is the severe damage done to the scientific infrastructure of Kuwait thus limiting the current in-country analytic capabilities. Any response by the US would have to include both training and equipment.

The Team has stressed, however, that their observations represent only a preliminary assessment and that considerable follow-up will be necessary to evaluate definitively the nature and magnitude of the human health, ecological, and atmospheric effects of the oil fires.

III. PROPOSED PROGRAM

The local populations are being exposed to an increased health risk, the magnitude of which cannot be estimated with any degree of certainty without further measurements and surveys. The extent to which conditions may worsen needs to be understood and a forecast capability developed. Without such measurements and assessment, and development of a predictive capability, the regional population remains exposed to an uncertain risk, and reconstruction of the area may be impeded. Moreover, without such input, an accurate and defensible quantification of environmental effects will not be possible.

In addition to providing direct answers to questions regarding the effects of the smoke plumes on the atmospheric environment, intensive studies of the plumes will accelerate progress in understanding manmade effects on regional and global air quality, meteorology, and climate. Because the expected changes in air chemistry, solar radiation, and cloud microstructure are so large, observations of these processes could circumvent the need for many years of study directed at much lesser phenomena.

The program proposed below is comprised of three primary elements: human health surveillance and risk assessment, air monitoring, and development of a forecast capability. These elements will be closely linked to achieve the goals of understanding and predicting the degree of human health risk and the effects on atmospheric processes.